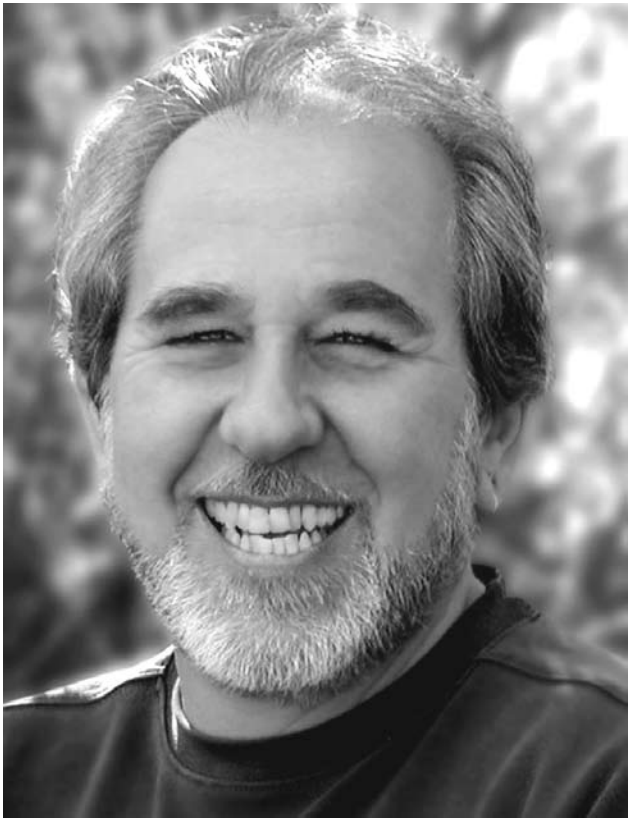
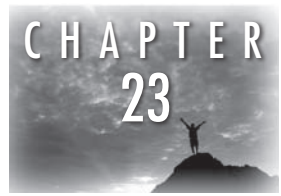


Bruce H. Lipton, PhD, author of *The Biology of Belief,* is an internationally recognized authority in bridging science and spirit. A cell biologist by training, he taught cell biology at the University of Wisconsin School of Medicine and later conducted pioneering research at Stanford University. His breakthrough studies on the cell membrane presaged the new science of epigenetics and have made him a leading voice of the new biology. Bruce Lipton was born on October 21, 1944, in Mount Kisco, New York.

Bruce H. Lipton



Aging: Belief or Biology

A character of all multicellular organisms in the biosphere is that their life progresses through a defined series of sequential stages that collectively define a life cycle. In the animal kingdom, the life cycle stages are: conception, development, maturation, decline, and death. Though death may be inevitable, the duration of an individual's life span is an unknown variable.

As a linear time line, the whole life cycle represents a process of aging. The conventional usage of "aging," however, is generally associated with the phase of the life cycle defined as decline. The period of decline is characterized by a loss of physical and mental function, decrepitude, and infirmity, all traits of "growing old."

The human aging period is of variable duration. Some individuals experience a long, protracted period of decline, while others are fortunate enough to have a vibrantly healthy life and then pass peacefully in their sleep, essentially without experiencing any infirmity.

Must a period of degeneration, "aging," precede death? Can we get old without aging? According to conventional biology, the answer is no. To understand that answer from a scientific perspective requires a little insight into the nature of biology and our bodies.

Immortal Cells and the Community

When life was first created on this planet, natural death did not exist. "Primitive" single-celled organisms, such as bacteria, fungi, algae, and protozoa (e.g., amoebae and paramecia), were immortal. Cells would grow until they reached a certain size; they would then divide, forming two daughter cells, which in turn would repeat the cycle. If unicellular organisms would age and die, then they would not provide a sustainable lineage. Think of it this way. The amoeba you see under a microscope today is technically the same cell as the

original amoeba that existed more than three billion years ago. Now that's the kind of aging we can live with!

In the course of evolution, single-celled organisms increased their survivability by teaming up with other single cells to form communities. These primitive assemblies, known as colonial organisms, are afforded two fundamental life-enhancing benefits: 1) Efficiency enhances survival. Communal life is more efficient as exemplified by the adage "Two can live as cheaply as one." 2) Awareness is one of most important contributing factors to survival. Community offers individual cells increased awareness. Every cell possesses awareness and has access to the collective awareness of all the other cells in the community.

Though they live as a "community," colonial cells still behave as independent single-celled organisms. If the cells of a colonial organism are dispersed, every cell can survive on its own. When a dispersed colonial cell divides, its daughter cells stay in close proximity, forming the seed of a new colony. The population of the colony increases through the continued cell divisions of the daughter cells' progeny. Large communities frequently fragment and each of the fragments enlarge until they too fragment.

Over time, the populations of the colonies grew so large that they could only sustain themselves by having constituent cells take on specialized jobs. Rather than all cells being the same, cells began to differentiate and express specialized functions such as muscle, bone, skin, and nerve. There was, however, a profound cost for this evolutionary advancement: The acquisition of a differentiated state interferes with the cell's ability to divide. As these cells mature, rather than undergoing mitosis and producing more progeny, they age and eventually die.

The continuous loss of differentiated cells would inevitably lead to the death of the community. To sustain survival, multicellular communities maintained a population of cells that do not differentiate and therefore retain their ability to divide. These "immortal" cells, called stem cells, maintain a continuous cycle of growth and proliferation. Stem cell progeny are the equivalent of "embryonic" cells, and when needed by the community, they can differentiate into any of a body's specialized cell types. Stem cell populations provide for a renewable source of differentiated cells. Stem cell populations are needed to sustain the life span of multicellular organisms, including human beings.

Body cells have different life spans. Some cells, such as those lining the gut, only live three days; others cells, such as neurons and some classes of immune system cells, survive for decades. The

human body loses billions and billions of differentiated cells every day due to aging and normal attrition. Stem cell progeny continuously replenish the body's differentiated cell population. Feasibly, stem cells should allow humans to survive indefinitely. Since stem cells are the equivalent of embryonic cells and continuously replace older cells, we may rightfully ask, "Why do we age and die?"

Insight into the answer to that question was first provided by the experiments of microbiologist Leonard Hayflick who in 1962 followed the reproductive fate of single cells in a tissue culture dish.[1] His results revealed that normal human and animal cells in culture have a limited capacity for replication. The results suggest that animal cells are not immortal.

In his studies, a typical cell would provide for fifty to sixty normal cell divisions, a phenomenon known as the "Hayflick limit." As the number of cell divisions approaches this limit, the subsequent daughter cells begin to express life-threatening dysfunctions and a decline in vitality. Each additional division further diminishes the cell's ability to survive and, inevitably, its death leads to the extinction of the cell line. Hayflick's research focused attention on the finite cellular life span as the fundamental source of aging. He suggested that cellular immortality, a key feature of tumor cells, was a pathological abnormality.

According to Hayflick's findings, stem cells will maintain the normal health of the body until they have exceeded a certain number of cell divisions. After that time, stem cell progeny become dysfunctional. Body tissues and organs populated with these "aged" cells go into decline and manifest the characteristics of aging. Inevitably, the dysfunctions become so great the body cannot sustain life processes and dies. Based on his observations, Hayflick and his associates vehemently condemned "anti-aging medicine," criticizing both the feasibility and desirability of human life extension.

Scientists initially attributed cellular aging to defects in the replication process that introduce mutations into the genes. DNA copying errors contribute to a loss of cell function that is physically expressed as aging. Molecular biologists have subsequently discovered, however, a set of specialized enzymes that comprise a system for DNA repair. These enzymes function as proofreaders that read the gene's code and correct mutations that are accidentally introduced into the DNA. Repair enzymes catch almost all errors that occur in the replication of DNA. Consequently, this repair mechanism would presumably serve as a means to prevent the hypothesized loss of stem cell function.

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1. Hayflick L (1965). "The limited in vitro lifetime of human diploid cell strains." *Experimental Cell Research* 37:614–636.

More recently, scientists have attributed cellular aging to alterations in a very specific region of the DNA helix called the telomere.[2] Telomeres are extensions on the ends of the DNA molecules that resemble the plastic tips that cap the ends of shoelaces. When a shoelace loses its plastic tip, the threads comprising the lace unravel and become frayed, making the shoelace dysfunctional. Similarly, when the DNA double helix loses its telomere cap, the DNA helix unwinds (i.e., frays), compromising the integrity and structural stability of the DNA.

Researchers discovered that every time a cell divides, a short length of each telomere is lost during the replication of the DNA helix. After a certain number of cell divisions, the telomeres would be lost, which in turn leads to destabilization and dysfunction of the genes. Telomere research supports Hayflick's findings that an organism's life span is determined by a specific number of cell divisions, by directly linking telomere length to the number of potential cell divisions.

Molecular genetic research has recently undermined this hypothesis. It has been found that cells possess an enzyme identified as telomerase that extends the length of telomeres. When activated, this enzyme would presumably maintain telomere length and allow cells to divide forever.[3]

Though challenged, science still favors the telomere story of aging since it conforms to the conventional belief that genes control our traits. Unfortunately, acceptance of this belief acknowledges that in regard to aging, we are victims of forces outside our control and must accept physiologic degeneration as an unforgiving fact of life.

An Aging Story We Can Live With

And now for something completely different—an aging story we can live with.

The story of cellular senescence just described is very much the same story of aging I was teaching medical students back in the early seventies. My research on cultured stem cells at that time, however, provided a radically new understanding of the mechanisms that control life. In my experiments, a single stem cell would be isolated and placed into a culture dish. The cell would subsequently divide

2. Verdun, R. E, and Karlseder, J. (2007). "Replication and protection of telomeres." *Nature* 447:924–931.

3. Zhao Y-M, et al. (2008). "Cell cycle dependent telomere regulation by telomerase in human bone marrow mesenchymal cells." *Biochemical and Biophysical Research Communications* 369:1114–1119.

and form two daughter cells. These cells divided and formed four cells. Over several days of reproducing, there were thousands of cells in the dish.

The unique character of all the cells in the culture dish was that they were genetically identical, having been derived from the same parent cell. The cell population was split into three different portions inoculated into three culture dishes. Each dish was fed growth medium containing a different chemical composition. For a cell, growth medium represents the "environment" in which it lives.

After several days, the fate of the cells was profoundly altered. In one culture, the stem cells became muscle; in the second dish, they became bone; and in the third dish, the cells differentiated as fat cells. The point is all cells were genetically identical when introduced into the culture dish, so the genes did not control their differentiated fate. Their fate was controlled by the environment, a finding in direct conflict with the dogma that genes control life.[4]

When cultured cells are fed a less than healthy growth medium, they get sick and begin to die. If the medium is replaced with a more supportive medium, the cells recover their health and thrive. This research emphasizes that the environment controls the genetics and the health of the organism. The profound joke is that human beings are, in reality, skin-covered Petri dishes containing over fifty trillion cells. The fate of cells in the human body, like that of the cells in a culture dish, is directly influenced by the environment in which they live.

This work presaged today's most exciting new field of science: epigenetic control. The conventional model of genetic control literally means "control *by* genes." The meaning of epigenetic control is profoundly different. The difference is emphasized in the Latin prefix *epi,* which means "above." For example, epidermis means the layer above the dermis, the skin. Epigenetic control literally reads as "control *above* the genes."

By 1990, science had clearly established that "When a gene product is needed, *a signal from the environment,* not an emergent property of the gene itself, *activates expression of that gene.*" (italics, mine) The profound essence of molecular biologist H. F. Nijhout's quote is simplified by reading just the italicized phrases, "*…a signal from the environment…activates expression of that gene.*"[5]

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4. Lipton, B. H. (1977). "A fine structural analysis of normal and modulated cells in myogenic culture." *Developmental Biology* 60:26–47.

5. Nijhout, H. F. (1990). "Metaphors and the role of genes in development." *BioEssays* 9:441–446.

Simply, the new science of epigenetic control is the study of how environmental signals control genetics and cell behavior.

Over the past fifteen years, leading edge science has revised its prevailing belief that genes control life. Unfortunately, these revisions are only recognized at the level of research scientists. The new insight on environmental control of genes through epigenetic processes is only now entering into public awareness.

Masters of Our Fate

The significant difference between the older conventional version of genetic control and the newer insights of epigenetic control is that the former emphasizes that we are "victims" of heredity, while the latter reveals we are actually masters of our fate, for we are free to change our environment and consequently change our lives.

As described in my book *The Biology of Belief: Unleashing the Power of Consciousness, Matter, and Miracles,* the human brain is the interface between the environment and the genes of our cells.[6] In response to environmental stimuli, the brain adjusts the composition of the body's tissue fluids, the equivalent of "growth medium" for our body's cells.

In the exact same way, the growth medium constituents regulate the genetics of cultured stem cells, and brain regulated chemistry of the blood and tissue fluids regulates the genetic expression of the cells that comprise our tissues and organs. Neurological perceptions are translated into biochemical cascades that control the genetics and behaviors of our cells. When we change our perceptions, our "beliefs," we change our body chemistry and epigenetically influence the fate of our cells.

Conventional medical practice is scientifically outdated since it still adheres to the notion of the primacy of genes in controlling our traits in health and disease. This perspective fosters the image that our fifty-trillion-celled bodies are genetically controlled mechanical vehicles. By contrast, epigenetic science profoundly modifies that belief. Though it still acknowledges the body as a vehicle, epigenetics introduces the concept of a driver—the mind. The perceptions of life we hold in our minds control our biology via epigenetic mechanisms. Through this process, the mind creates a biological response that complements our perceptions or beliefs about life.

An individual with good driving skills can maintain and enjoy good performance of a vehicle throughout its lifetime. Bad driving

6. Lipton B H (2005). *The Biology of Belief.* San Rafael, CA: Mountain of Love Productions and Elite Books.

skills are responsible for most of the wrecks that litter the roadside and fill junkyards. The influence of a driver's skill holds true for any vehicle, be it an automobile or a human body.

Employing good "driving skills" in the management of our behaviors and the maintenance of our vehicular bodies offers an opportunity for a healthy, happy, and productive life. Inappropriate and dysfunctional behaviors, in addition to a neglect of bodily maintenance, stresses our cellular "vehicles," interferes with their performance, and ultimately provokes a breakdown.

Are you a good driver or a bad driver? Before you answer that question, realize that there are two separate minds that provide the body's controlling "central voice." The (self-) conscious mind is the thinking you; it is creative and expresses free will. It is the mind that has all your wishes, desires, and aspirations. The self-conscious mind is the one that hopefully visualizes a life filled with health and happiness.

Since almost everyone holds a conscious desire of vitality and wellness in their minds and the mind is supposed to control our biology, you may rightfully ask, "Why are we so plagued with ill health, disease, and the decrepitude of aging?"

Good question. The answer lies in this fact: Neuroscientists have found that the conscious mind controls our biology less than 5 percent of the day; 95 percent of our life is actually under the control of programs in our subconscious mind.

The subconscious mind is an entirely different entity from the conscious mind. It is a record-playback device that is a million times more powerful information processor than the conscious mind. The subconscious contains a database of reflexes and learned perceptions that are directly downloaded from our life experiences. Recorded as stimulus-response programs, automated subconscious behaviors are expressed as "habits." Habits free the conscious mind from spending valuable processing time on repetitive behaviors that range from standing and walking to driving a car.

Most subconscious programs are acquired, "learned," and are used to automatically adjust the biology and behavior of the body without the observation or participation of the conscious mind. That's why it is referred to as the "*un*conscious" or "*sub*conscious" mind.

The subconscious mind is not a seat of reasoning; it is strictly a stimulus-response device. When an environmental signal is perceived, the subconscious mind reflexively activates a previously programmed behavioral response—no thinking required. The

subconscious mind is a programmable autopilot that navigates the vehicle without the necessity of observation or awareness by the "pilot," the conscious mind.

In contrast to the conscious mind, which has your wishes and desires, the subconscious mind's programs are primarily beliefs copied from observing others. The meaning of this awareness is profound and sobering: "We" control our lives less than 5 percent of the time, while other people's programs control our biology 95 percent of the time. We are essentially living other people's lives.

The dual-mind system's effectiveness is defined by the quality of perceptual programs stored in the subconscious mind. Essentially, the person who taught you how to drive molds your driving skills. For example, if you were taught to drive with one foot on the gas and the other on the brake, no matter how many vehicles you own, each will inevitably express premature brake failure.

Youth-ing Ourselves

From the perspective of "new-edge" science, the character of an individual's aging is primarily a reflection of their subconscious beliefs and not their genetic history. As discussed in *The Biology of Belief*, the EEG activity of the brain through the first six years of life reveals that a child's mind is primarily engaged in a hypnotic trance. Consequently, whatever the child experiences or learns during this critical period of development is directly downloaded into the subconscious mind.

These acquired developmental perceptions represent the fundamental beliefs that essentially control the biology of an individual for the rest of his or her life. This conclusion is supported by recent medical studies revealing that the propensity of experiencing a disease in adulthood is determined by environmental influences during the periconceptual, fetal, and infant stages of life.

During this important period of development, a child downloads into its subconscious memory a program of aging by observing the physical character of people in its community. An infant readily connects infirmity and physical degeneration as a pattern associated with aging. More important, the subconscious programming of aging is further emphasized because it is linked to one of the most important facts of life any human learns—mortality. Aging patterns take on a profound significance in our minds because they are associated with death.

The perception that our mental and physical abilities must fade as we age is a notion that we now accept as fact, though it is patently not true. The new science suggests that we age according to our beliefs. When we "feel" we are too old to do something, we commit to an aging program and the brain will ensure that our biology matches our beliefs. Does this new science suggest that we can eliminate, or at least profoundly limit, degenerative changes associated with aging? Absolutely!

A fabulous experiment revealing the ability to "youth" ourselves by changing our perceptions was provided by Harvard psychologist Ellen Langer.[7] In 1979, Langer selected a group of elderly men from a retirement community and ran them through a battery of tests to evaluate their mental and physical parameters. The group was then taken on a retreat to a lodge where the clothing, food, magazines, music, memorabilia, and even the conversation were from 1959, twenty years earlier. After spending just five days in this environment of "altered" time, the participants went through the same tests they took before the retreat. The tests revealed that with just a few days of mentally "living" in the past, these men dramatically reversed their physical and mental traits and had test results similar to subjects who were twenty years younger. By simply changing their environment, people can actually reverse aging!

When we align our subconscious programming with our conscious desires, we become the masters of our fates rather than the "victims" of our programs. Historically, it has been a tedious and time-consuming process to effect changes in limiting or sabotaging subconscious programming. Fortunately, a new variety of rapid and efficient reprogramming processes are available to rewrite limiting programs, such as those we acquire about aging. For a listing of effective behavioral reprogramming methodologies, as well as more detailed information on this new science, visit www.brucelipton.com.

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7. Langer E (1989). *Mindfulness.* Reading, MA: Addison-Wesley.